PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

THIRTEENTH ANNUAL MEETING
1937-1938

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HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Thirteenth Annual Meeting were held in Dean Hall, University of Hawaii, December 2 and 3, 1937, and May 5 and 6, 1938, ending with a banquet at the Pacific Club on May 7.

OFFICERS

1937-1938

President, Oscar C. Magistad[1]
Acting President, Willard H. Eller
Vice-President, Walter Carter
Secretary-Treasurer, Mabel Slattery
Councilor (2 years), Willard H. Eller
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1938-1939

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Councilor (1 year), Willard H. Eller
Councilor (1 year), Ralph J. Borden.

[1] Resigned, March 1938.

PROGRAM OF THE THIRTEENTH ANNUAL MEETING

THURSDAY, DECEMBER 2, 1937, 7:30 P. M.

Preliminary announcements.

Presentation of papers:

Willard H. Eller: Measurement of earth tilts.

Stanley S. Ballard and John H. Payne: Preliminary analyses of Kilauea solfataric gases.

Otto H. Swezey: Misidentity of immigrant insects in Hawaii.

George C. Munro: Preservation of our shore waterfowl and waders. (By title only.)

Nils P. Larsen: The relation of diet to infection.

FRIDAY, DECEMBER 3, 1937, 7:30 P. M.

Preliminary announcements.

Election of members.

Presentation of papers:

Chester K. Wentworth and Austin E. Jones: Intrusive rocks of the leeward slope, Koolau Range, Oahu.

Harold T. Stearns: Geologic history of West Maui, Hawaii.

Joseph E. Alicata: Recent contributions to the knowledge of human parasitism in Hawaii.

Edward Y. Hosaka: The life-forms of the flowering plants of Kipapa Gulch, Oahu. (By title only.)

C. E. Pemberton: Collecting wild sugar cane in New Guinea.

THURSDAY, MAY 6, 1938, 7:30 P. M.

Preliminary announcements.

Appointment of committees.

Presentation of papers:

Chester K. Wentworth, R. C. Wells, and V. T. Allen: Ceramic clay in Hawaii.

Constance E. Hartt: Sugar transformations in the cane plant.

Arthur R. Beach and Willard H. Eller: A study of the magnetic properties of Kilauea rock.

O. N. Allen and Ethel K. Allen: Strain variation and host specificity of Rhizobia within the cowpea cross-inoculation group.

Stephen B. Jones: The weather element in the Hawaiian climate.

Alvin Dougan: Tuberculosis in Hawaii.

FRIDAY, MAY 6, 1938, 7:30 P. M.

Preliminary announcements.

Presentation of papers:

Nils P. Larsen: Analysis of certain factors entering into the material welfare of families.

Winston W. Jones: The physiology of oil production in the macadamia.

Stanley S. Ballard: Qualitative spectrochemical analysis in agriculture.

William B. Storey: Segregation of sex types in the papaya.

E. Y. Hosaka and J. C. Ripperton: Grasses in Hawaii. (By title only.)

M. B. Linford: Potential agents of biological control of plant-parasitic nematodes.

SATURDAY, MAY 7, 1938, 6:30 P. M.

Pacific Club banquet.[2]

Constitutional order of business.

Election of members.

Installation of officers.

Invitational address by Harold St. John: The jungles of Fiji.

[2] Acting president Willard H. Eller presiding in the absence of Vice-president Walter Carter.

ABSTRACTS OF PAPERS

MEASUREMENT OF EARTH TILT

By

WILLARD H. ELLER

Earth tilt is a change of the angular relation between some part of the earth's surface and the horizontal. It is usually slight, requiring the use of sensitive instruments for its measurement.

Probably the most accurate and sensitive method for tilt measurement is that devised by Merritt, utilizing the interference of light waves. Interference fringes are obtained in a thin wedge-shaped film of air contained between two plane surfaces, one of which tilts with the earth, while the other remains level. The magnitude of the tilt is obtained from a relation between the measured fringe separation and the wave length of the light used, and the direction of the tilt from the orientation of the fringes.

Most other methods of tilt measurement use some form of pendulum. A simple pendulum is not suitable, for to obtain one millimeter displacement of the lower end of the pendulum with even one second of tilt would require a pendulum 20,000 centimeters long. Magnification of the pendulum motion is possible, as is done with the pendulum-type tiltmeters in use at Kilauea, but this has its limitations.

A most satisfactory form of pendulum-type tiltmeter results from the use of the horizontal pendulum. I am now working toward the development of a high sensitivity tiltmeter of this type which will not be affected by earthquake shock, will record the tilt hourly, and require attention only once a week. A model of this device was installed at the Hawaiian Volcano Observatory in the summer of 1937. It is still performing satisfactorily (Dec. 1937), but is of too low sensitivity for most tilt measurement.

PRELIMINARY ANALYSES OF KILAUEA SOLFATARIC GASES

By

STANLEY S. BALLARD AND JOHN H. PAYNE

Collections of Kilauea solfataric gases were made in September 1936 and in August and December 1937. Most of the collections were made from the manifold connecting the three wells sunk some years ago at the Sulfur Bank near the Hawaiian Volcano Observatory. Other collections were made in this locality and at the Steaming Bluffs, using a field collection technique. The

purpose of the program was to establish the identity of all constituents other than the obvious steam and sulfur vapor. A preliminary analysis of the gases was made by E. T. Allen of the Geophysical Laboratory of the Carnegie Institution in 1922. He reported finding 96.2 percent steam, .004 percent sulfur vapor, .096 percent sulfur dioxide, 3.7 percent fixed gases, and a trace of hydrogen chloride. We used a combination of chemical and spectroscopic methods of analysis. The chief constituent of our collections (other than steam) was carbon dioxide, which constituted as much as 95 percent of some samples. Sulfur dioxide was present in amounts equal to 2 to 3 percent of the carbon dioxide content. Oxygen and nitrogen were present always approximately in the normal atmospheric ratio, but in absolute amounts which varied widely from sample to sample, being larger in the field collections than in the wells collections. Argon was present in the nitrogen residues, but no other rare gases were detected. No significant trace of the combustible gases ordinarily associated with volcanism was detected in any sample. It is interesting to note that even the Steaming Bluffs sample showed a definite, though small, content of sulfur dioxide and carbon dioxide. In general these results do not seem to be incompatible with the partial analyses of Dr. Allen, if one interprets his 3.7 percent of fixed gases to consist of some carbon dioxide but chiefly air.

MISIDENTITY OF IMMIGRANT INSECTS IN HAWAII

By

O. H. Swezey

When an immigrant insect appears in Hawaii, entomologists immediately attempt to ascertain its identity and whence it came. This has been of special importance with those which are pests. Many new immigrants have been incorrectly identified, and have been known for a time by an erroneous name. This has resulted in considerable confusion in entomological literature especially in regard to geographical distribution. It is difficult to change the name of an insect when a name found to be incorrect has been used for a long time.

Herewith is a list of some of the commoner immigrant insects in Hawaii which have been misidentified, and the present accepted name for each. It is possible, however, that some future systematists may find that the correct names have yet to be established. The names as now given are on the authority of a number of entomologists who are experts in particular families or groups of insects. Some of these corrections have already been recorded in the Proceedings of the Hawaiian Entomological Society or in other publications.

Common name	Misnomer	Present accepted name
Sugar cane leafhopper	Dicranotropis vastatrix Bredd.	Perkinsiella saccharicida Kirk.
Chinese rose beetle (Japanese beetle)	Adoretus umbrosus (Fabr.) Adoretus tenuimaculatus (Waterh.)	Adoretus sinicus Burm.
Fullers rose beetle (Olinda beetle)	Pantomorus olindae Perkins Aramigus fulleri Horn Pantomorus godmani (Crotch)	Asynonychus godmani Crotch
Sweet potato weevil	Hyperomorpha squamosa Sharp Euscepes batatae (Waterh.)	Euscepes postfaciatus (Fairm.)
Small banana weevil	Calandra remota Sharp	Polytus mellerborgi (Boh.)
Carpenter bee (Bumble bee)	Xylocopa aeneipennis (DeGeer) Sylocopa brazilianorum (Linn.)	Xylocopa varipuncta Patton
Black megachilid	Lithurgus albofimbriatus Sich.	Lithurgus scabrosus (Smith)
Leafcutter bee	Megachile palmarum Perkins	Megachile gentilis Cresson
Shorthorned grasshopper	Oxya velox (Fabr.)	Oxya chinensis (Thunb.)
Coneheaded grasshopper	Atractomorpha crenaticeps Blanch.	Atractomorpha ambigua Bol.
Longhorned grasshopper	Xiphidium fuscum (Fabr.) Xiphidium varipenne Swezey	Conocephalus saltator (Sauss.)
Japanese katydid	Holochlora venosa Stal.	Holochlora japonica Brunn.
Preying mantis	Tenodora sinensis Sauss. Paratenodora sinensis (Sauss.)	Tenodora angustipennis Sauss.
Assassin bug	Zelus peregrinus Kirkaldy	Zelus renardii Kolenati
Pink sugarcane mealybug	Pseudococcus calceolariae (Mask.) Pseudococcus sacchari (Ckll.)	Trionymus sacchari (Ckll.)
Gray sugarcane mealybug	Pseudococcus sacchari (Ckll.) Pseudococcus sacchari folii (Green) Trionymus calceolariae (Mask.)	Pseudococcus boninsis (Kuwana)
Pineapple mealybug	Pseudococcus bromeliae (Bouche)	Pseudococcus brevipes (Ckll.)
Nutgrass armyworm	Spodoptera mauritia (Boisd.)	Laphygma exempta (Walker)

PRESERVATION OF OUR SHORE WATERFOWL AND WADERS

By

G. C. MUNRO

This is an appeal to all who are interested in doing what they can to gain better protection for the birds of the Territory: the native birds—hawk, owl, stilt, heron, mudhen, coot; migratory birds—pintail and spoonbill ducks, golden plover, wandering tattler, bristle-thighed curlew, turnstone, sanderling; and others that straggle here. They have claims for many reasons, scientific, material, sentimental, and aesthetic.

Government protection is not enough. The formation of sanctuaries where shooting is prohibited is important, and their care is equally so. Encroaching introduced plants and noxious animals must be kept in check or some of our shore birds cannot survive.

A careful study should be made of the life of the migrants when away, and especially of the probable effect on the birds of the recently introduced toad in denuding the ponds of the small fishes which no doubt are a regular food for some birds and a standby for the plover on their return when the moths and larva of cutworms and army worms are scarce. (See Fauna Hawaiiensis, vol. 1, pt. IV: "Vertebrata" pp. 449-450, by R. C. L. Perkins, on the plover's value in keeping down pests.)

Any introduction of new plants and animals, even when carefully studied, is attended with risk; on the other hand, without new introductions there is little progression. This emphasizes the necessity of a thoroughly trained ornithologist to keep up an exhaustive study of every phase of the bird life of the Territory and intended introductions which might affect bird life.

THE RELATION OF DIET TO INFECTION

By

NILS P. LARSEN

The words "protective food" have come into increasing use during the last few years. The "protective" nature of vitamins is well known and was briefly reviewed. These observations by The Queen's Hospital Research Department are an attempt to gather evidence as to whether we are justified in assuming that diet has a definite relationship either to preventing infection, or helping the patient to overcome it. This was a field study conducted during the past year on two groups of Japanese families. The diet values in rela-

tion to quantity of carbohydrate, protein, fat, calcium, iron, and other ingredients, were tabulated. The greatest difference in food quantities was the fact that one group had less than half the amount of fruit and vegetables consumed by the second group. There was also a difference in milk consumption.

During the time of study, a measles epidemic affected practically every child on the plantation. Those in the high fruit and vegetable group averaged one half as many days in bed per person as those in the low group. The latter group recorded 582 sick days in bed as against 196 sick days for the high fruit and vegetable group. There were three deaths in the low fruit and vegetable group, none in the other group.

I felt justified in stating that the evidence lent some support to the connotation "protective foods" used in relation to infections. Comment was also made on the ability of the body to vary the availability of certain food elements, depending on long continued low or high intake, or the increasing efficiency of use by the body if a certain element is taken in certain combinanations.

Special appreciation and thanks are given to A. Y. L. Ward and J. Matsuoko whose combined assistance made this study possible.

INTRUSIVE ROCKS OF THE LEEWARD SLOPE, KOOLAU RANGE, OAHU

By

CHESTER K. WENTWORTH AND AUSTIN E. JONES

Most dikes, with a few sills, of the Koolau Range are concentrated in the linear dike complex, windward of the topographic crest. Here dikes are subparallel to the trend of the range and complex and have a transverse spacing of 50 to 500 to the mile. Besides these dikes, which represent the main feeder system by which the Koolau dome was built, are scattered dikes throughout the mass of the dome. Detailed studies in the Honolulu area and more casual observations elsewhere show that the scattered dikes occur in linear systems, and that these systems and their component dikes trend down the dip of the lava flows from the crest of the range to the sea, and hence in a direction nearly at right angles to that of the dike complex. In the Palolo-Waialae area, traverses have been made with sufficient uniformity to permit plotting of a contour map showing the dike concentration at various points. In general concentration decreases progressively down slope from the dike complex and in a large part of the lower slope of the dome not over one dike per mile has been observed. A tongue of marked concentration extends southward from Kaau Crater, though the dikes found are all cognate with the

ancient Koolau lava series and no nephelite-mellilite dikes related to the relatively recent Kaau basalt have been found. Columnar-jointed dikes occur at depths below two or three hundred feet; banded, vesicular dikes of more obscure lines are characteristic of shallow intrusion. Associated with some shallow dikes are intrusive masses here called "buds." They represent thickened, expanded and rounded parts of a dike where lava was extruded to the surface of the existing dome. Some are 20 by 40 feet in plan, with selvage and banded structure similar to the dikes.

GEOLOGIC HISTORY OF WEST MAUI, HAWAII

By

HAROLD T. STEARNS

West Maui is an eroded volcano 5,788 feet high connected by a narrow strip of low land to Haleakala Volcano, 10,025 feet high. These two masses make up the island of Maui. The important stages in the geologic history of West Maui follow:

Probably late Tertiary and early Pleistocene (?) time

1. Building of shield-shaped volcano of basalt flows and a few thin beds of agglomerate about 7,000 feet high in relation to present sea level over a northeast-southwest rift. Fissure eruptions were not confined exclusively to this rift, as numerous dikes radiate from the apex of the volcano.

2. Collapse stage with the formation of a caldera about 2 miles across and several hundred feet deep on the summit. This caldera slightly enlarged and with all of its floor eroded away now forms the amphitheater head of Iao Valley. A smaller crater perhaps a part of the caldera lay to the south as shown by the throat breccia exposed at the head of Waikapu Valley.

3. A relatively short rest period during which a thin soil formed and differentiation took place in the feeding magma reservoir.

4. Outpourings of thick trachyte flows from local vents located along fissures. These flows formed a veneer over most and perhaps all of the basaltic dome.

5. Cessation of volcanism followed by a long epoch of weathering and erosion. A drainage pattern was established and canyons as much as 4,000 feet deep were carved. The parts of the shore exposed to strong wave action were cliffed.

Pleistocene time

6. Submergence of an unknown but large amount, perhaps as much as 2,500 feet, causing the mouths of the valleys to be drowned and their floors to be alluviated.

7. This submergence culminated in short halt at about 1,200 feet above present sea level.

8. Gradual emergence of possibly as much as 1,500 feet, or to about 300 feet below the present strand with probably several short halts. One of these halts about 250 feet above present level is named the Olowalu shore-line from the fossiliferous marine deposits at this altitude near Olowalu.

9. Resubmergence to about 100 feet above present level causing a new period of valley alluviation. Thick conglomerates were laid down at the foot of the east slopes of the mountain.

10. Reemergence of about 160 feet or to about 60 feet below present sea level leaving shore flats dry and much loose sand exposed to wind. Large dunes of calcareous sand were formed near Wailuku and some sand drifted about 6 miles across the neck of land connecting East and West Maui to the lee shore. Scattered eruptions produced short flows and cinder cones, chiefly of nephelite basalt, near Malaaea, Olowalu, and Lahaina about this time.

11. Resubmergence of about 85 feet and the formation of a shore-line about 25 feet above present sea level during which some of the dunes were drowned and others cliffed.

12. Reemergence of about 20 feet with the formation of a fringing shore bench about 5 feet above the present strand.

13. Further emergence to the present strand.

The periods of emergence were times of stream erosion and the periods of submergence were times of stream deposition except in the steep heads of the valleys. Marine erosion continued throughout the Pleistocene along the parts of the shore exposed to rough seas.

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RECENT CONTRIBUTIONS TO THE KNOWLEDGE OF HUMAN PARASITISM IN HAWAII

By

JOSEPH E. ALICATA

(Public Health Repts., vol. 53, no. 10, 1938; Jour. Am. Med. Assoc., vol. 110, 1938)

During 1936 and 1937, three important parasitic diseases of man have been found in the Territory, namely, trichinosis, spirochaetal jaundice, and intestinal distomiasis. The discovery of trichinosis on Hawaii (April 1936) led to a survey of animals that might serve as carriers to ascertain the prevalence of

this disease. Following the survey on Hawaii, reported to the Academy last year, the work was extended to Maui, Oahu, and Kauai. A summary is given below.

Animals examined	Number of animals examined			
	Hawaii	Maui	Oahu	Kauai
Rats	2,130	1,094	352	601
Mice	306	33	2	2
Mongooses	70	22	1	
Hogs (wild)	41	2		2
Hogs (domesticated)	61	92	130	30

Infection with trichinae was found in the animals examined on Hawaii as follows: rats, 2.6 percent; mice, none; mongooses, 24.2 percent; wild hogs, 14.6 percent; domesticated hogs, 1.6 percent. On Maui, the infection was found in only one rat and two mongooses; no infection was found on Oahu or Kauai.

The spirochaetal jaundice organism, *Leptospira icterohemorrhagiae,* was noted in the urine of a patient at Pepeekeo Hospital, Hawaii, in October 1936. A guinea pig, inoculated with this urine, became infected, and died of jaundice after 9 days. In addition, of 30 rats trapped near Pepeekeo, 5 were found infected with *Leptospira.* This organism was also found in rats caught on Kauai.

In June 1937, an infection with intestinal flukes (*Stellantchasmus falcatus*) was found in a young Japanese, born and reared in Hawaii, who reported having eaten raw fish, including mullet. Out of 25 mullet (*Mugil cephalus*) caught in ponds and salt water around Oahu, 23 showed infective cysts (*metacercariae*) of this fluke in the musculatures. Infestation was also found in 2 mullet caught in waters near Hilo, Hawaii. It may be emphasized that there is no danger of human infection from mullet that have been properly cooked.

More detailed reports of these studies are being published elsewhere.

LIFE-FORMS OF THE FLOWERING PLANTS OF KIPAPA GULCH, OAHU

By

EDWARD Y. HOSAKA

[B. P. Bishop Mus., Occ. Papers, 13(17), 1937]

In recent years the life-forms study of vegetation has become popular. The life-forms of a region are the result of the total effect of environmental factors; thus they manifest climate. There are several systems as postulated

by Humboldt, Kermer, Warming, and Raunkiaer. That of Raunkiaer has been most widely used because of its simplicity and applicability.

Raunkiaer bases his classification on a single structure, resting organ, which he interprets as the adjustment to unfavorable climate. On this basis, he distinguishes five main classes: phanerophytes, with their perennating buds over ten inches above the ground; chamaephytes, with buds below ten inches above ground; hemicryptophytes, with buds in the soil surface; chryptophytes, with buds buried in the soil or submerged in water; therophytes, perennating by seed.

Raunkiaer's system is useful in temperate regions but in the tropics it cannot be strictly applied. In the tropics, temperature conditions are favorable continuously throughout the year with moisture conditions locally and seasonally unfavorable. Hence most of the plants lack well-insulated buds or other resting organs that are found on plants in colder regions. Actually most of the plants grow throughout the year, or with but brief interruptions. In the study of the life-forms of Kipapa Gulch plants, the position of the growing points has been used in the attempt to apply the Raunkiaer system.

The life-forms of the plants in this region change with elevation. The life-form below 1,000 feet elevation is dominantly nanophanerophytes (herbs and shrubs), 1,000 feet to 2,000 feet elevation, micro- and meso-phanerophytes (tall trees), and 2,000 to 2,800 feet elevation, nano- and micro-phanerophytes (shrubs and dwarfed trees). The spectrum of Kipapa Gulch plants indicates a tropical region in possessing a relatively high percentage of phanerophytes indicating a warm, moist region, as compared to Raunkiaer's normal spectrum.

COLLECTING WILD SUGAR CANE IN NEW GUINEA

By

C. E. Pemberton

In view of the promising results already obtained by geneticists in the crossing of wild with cultivated canes and the limited number of the former so far utilized in such work, the Hawaiian Sugar Planters' Association sent C. G. Lennox and C. E. Pemberton, in January 1937, to New Guinea and some adjacent islands to study and collect seed of as many forms of wild cane as possible.

Using as headquarters, Rabaul, New Britain, the seat of government for the Mandated Territory of New Guinea, a survey was made of wild canes in coastal, river and mountain areas of New Britain, New Hanover, New Ire-

land, and New Guinea. Transportation was obtained on steamers, small motor boats, canoes, airplanes and much country was traversed on foot.

New Britain and especially New Guinea present high mountain areas and elevated grassy plateaus, offering a fitting environment for the evolutionary development of grasses. Wild canes were found to occupy an important place in the grass flora. Wide variations within certain definite types were found, supplying ample evidence of endemism. The paucity of wild canes on New Ireland and New Hanover can be explained by the heavy forest cover from coast to coast.

A large quantity of seed, consisting of over forty separate lots, was collected on New Britain and New Guinea. This was brought to Hawaii in June 1937, disinfected, and planted in flats within a special quarantine house maintained by the Hawaiian Sugar Planters' Association on Molokai. Several thousand vigorous seedlings, from eight to twelve feet in height and of numerous types, resulted after five months of growth. These will be released from quarantine some time during 1938, if disease free, and be ready for crossbreeding with commercial canes as soon as they flower.

CERAMIC CLAY IN HAWAII

By

C. K. WENTWORTH, R. C. WELLS[3] and V. T. ALLEN[4]

In the central Polynesian area, northeast of Fiji and Tonga, where there are no continental types of rocks, ceramic clay is generally absent. Weathering of basic volcanic rocks under tropical conditions does not ordinarily produce clays of ceramic quality. However, since 1935, small amounts of medium or light gray residual clay have been found in restricted upland areas on Oahu, Maui, Molokai, and Kauai. The deposits take the form of thin underclays, always overlain by a well-marked humus or peat layer at the modern surface, and usually underlain by thin but more or less continuous masses of iron pan followed by weathered, buff or brown residuum.

In every instance the clay occurs in sloping areas of little relief, remnants of original constructional surfaces of volcanic domes, which receive rainfall of 150 to 400 inches annually but have long remained free from significant disturbance by erosion or deposition. In elevations ranging from 2,500 to 5,500 feet, patches of more or less distinctive bog vegetation have developed and are apparently the basis of reducing conditions under which a clay fairly low in iron has been produced.

[3] Chief Chemist, U. S. Geological Survey, Washington, D. C.
[4] Professor of Geology, St. Louis University, St. Louis, Mo.

Three complete chemical analyses show a rather variable composition, silica 34 to 57 percent, alumina 22 to 26 percent, iron oxides 3 to 9 per cent. Most surprising is approximately 14 percent of titanium oxide in two of the samples. Preliminary petrographic studies show derivation of the clay by alteration of feldspars to kaolinite, and ferromagnesian minerals to a brown clay mineral not yet positively identified. On certain islands the clays may have been derived from trachyte, but the presence of rocks less basic than basalt on the Koolau Range of Oahu, near the clay deposits, has not yet been demonstrated nor considered essential to the production of the clay by weathering.

SUGAR TRANSFORMATIONS IN THE CANE PLANT

By

CONSTANCE E. HARTT

(Haw. Planters' Record, 41: 33-46, 1937)

Both leaves and stems of the sugar cane plant readily carry on interconversion of glucose and fructose as well as synthesis of sucrose, according to experiments in which excised blades, sheaths, and cut stalks of sugar cane were supplied with glucose or fructose in absolute darkness. Entire stalks of *Saccharum robustum,* a wild variety of sugar cane with naturally low sucrose content, were placed in a ten percent solution of glucose and fructose for 48 hours. The percentage of sucrose increased in the blades, the sheaths, and the stems. In the stems, the sucrose increased from 8.1 to 14.3 percent. Therefore cut stalks of sugar cane can absorb glucose through their cut ends, the glucose can go up to the leaves and be turned into sucrose, and some of the sucrose can return to the stem for storage.

Neither light nor chlorophyll is necessary for the interconversion of glucose and fructose or their transformation into sucrose. The gain in sucrose in blades supplied with glucose increased with temperature from about 10°C. to 40°C. and decreased at 50°C. Time and the concentration of glucose materially affect these processes. Sugar cane blades supplied with mannose made no sucrose. It is therefore unlikely that the interconversion of glucose and fructose in the sugar cane plant takes place by enolization, since mannose has the same enol form as glucose or fructose.

These findings demonstrate the importance of glucose as a forerunner of sucrose and indicate that part of the sucrose stored in the stem is made there from glucose transported to the stem from the leaf.

A STUDY OF THE MAGNETIC PROPERTIES OF KILAUEA ROCK

By

ARTHUR R. BEACH AND WILLARD H. ELLER

With a modified magnetometer of the type used in measuring earth's fields and two single turn coils reducing the control field at the magnet, it was possible to measure fields of about 1/1000 the strength of the earth's field.

The magnetic moment of the sample placed in EW axis was determined by the deflection of the magnet from the relation

$$M/H = d\ 3/2 \tan \theta$$

Magnetic poles were indicated by maximum deflection in either direction as the sample was rotated.

The results so far obtained indicate the following facts:

(1) That Kilauea lava is definitely magnetic;
(2) That the lava has a definite polarization;
(3) That lava, when heated to some temperature between about 800 degrees F. and 1,100 degrees F., can be magnetized by an applied field and its polarization is the same as that of the applied field (the determination of this critical temperature at which these phenomena occur is not yet completed);
(4) That most types of lava approach magnetic saturation when subjected to a field of about 30 times the strength of the earth's field, but up to this value the degree of magnetization is proportional to the applied field;
(5) That after lava has cooled there is no apparent change in its magnetic strength or polarization, even though subjected to very strong magnetizing forces.

It should be possible therefore to date lava flows by checking the polarization of the lava and comparing this with known magnetic declinations of past years.

STRAIN VARIATION AND HOST SPECIFICITY OF RHIZOBIA WITHIN THE COWPEA CROSS-INOCULATION GROUP

By

O. N. Allen and Ethel K. Allen

A study has been made of the infective and effective abilities of 54 strains of *Rhizobia* isolated from 28 species of leguminous plants when used as inocula for 20 plant members now included in the cowpea cross-inoculation group. Results have been based upon three replicative greenhouse experiments conducted under approximately the same meteorological conditions.

Marked differences were noted in the plant response to the various inocula in the greenhouse tests. Approximately 25 percent of the strains produced nodules upon all of the test plants, whereas the remaining strains were non-infective upon one to six different species. In regard to benefits derived from the inocula, 41 or 76 percent of the strains were non-effective upon five plants or less, while nine strains or 16 percent were non-beneficial upon six to nine of the test plants. Forty-eight or 89 percent of the strains were beneficial upon 19 of the 20 species. Only six or 11 percent of the strains benefited the growth of less than ten of the plants tested.

Ten of the 20 test plants were inoculated by each of the *Rhizobia* strains. The cowpea plant (*Vigna sinensis* L.) was the most susceptible to the various inocula inasmuch as each strain of *Rhizobia* not only produced nodules but benefited its growth; while the other extreme was represented by the lima bean (*Phaseolus lunatus*) upon which only 22 strains produced nodules, none of which were beneficial.

An analysis of the results suggests that variations in the infectiveness and effectiveness of *Rhizobia* from plants of the cowpea group may be of a greater magnitude than those previously recorded for the other cross-inoculation groups.

THE WEATHER ELEMENT IN THE HAWAIIAN CLIMATE

By

Stephen B. Jones

Climate is customarily described by averages. In this study some climatic averages have been broken down to show the relative importance of weather types. Hawaii has two basic weather types—trade wind and southerly (kona)—each of which has rainy and dry subtypes. Analysis of Honolulu rainfall for five years shows that trade wind rain is relatively constant, while rain

due to extratropical cyclones (kona rain) is extremely variable. Kona rain is responsible for the winter maximum, trade wind rain showing no regular seasonal peak. It is estimated that the normal trade wind rainfall for Honolulu is about 250 millimeters. Mountain stations receiving more trade wind rain in proportion to the total, show no such marked summer minimum.

Trade wind rain is reemarkably constant in wet and dry years at all of five stations forming a profile across the Koolau Range, with the amount directly proportional to proximity to the mountain crest. Kona rain shows no such close relationship to topography, because much of the kona rain is frontal, not orographic. Stations on the northeast side of the range have more kona rain than stations on the southeast, due, probably, to the blowing over of convectively instable air. In an analogous way, the trade wind showers are blown southwestward.

Analysis of rainfall for the two wettest years (1887 and 1904) and two driest years (1878 and 1926) ever recorded at Honolulu shows that summer rain was approximately normal in all four, with the dry years showing rainier Junes than the wet years. In the dry years the customary rainfall curve was reversed, the minimum coming in winter.

Temperature variability is greatest at high altitudes and inland, and shows a slight winter maximum. Temperature fluctuations are usually caused by frontal passages or by vertical currents in instable air masses. Therefore, a rough correlation exists between temperature variability, the number of kona days, and the number of days with rainfall in excess of 2.5 millimeters.

SCIENCE IN TUBERCULOSIS CONTROL

By

C. Alvin Dougan

Tuberculosis in its epidemiological aspects has its source in a specific pathological phenomenon, the softening of the caseous tubercle.

The tubercle is the body's primary cellular defense against acid-fast invaders which apparently cannot be destroyed by the simple expedient of phagocytosis. The strategy of the tubercle is devitalization of the mauraud-ing pathogens by imprisonment and starvation. Walls of epithelioid or monocytic cells, reinforced by heavy fiber, are proliferated about the invading acid resistant microörganisms, while biochemical processes literally bury the imprisoned invaders in caseous, then calcified deposits to render them completely innocuous through starvation. Ultimately capillaries penetrate the derelict tubercles and remove the inert calcified remnants.

Under normal conditions of living, therefore, tuberculosis infection and pathological response is self-limiting.

Breakdown of the body's cellular defense, however, induced so characteristically and so commonly by the stress and strain of early adult life, gives rise and release to phenomenal numbers of virulent bacilli which disseminate and perpetuate disease. This softening of the caseous tubercle, associated as it is to the enormous multiplication, escape, and discharge of tubercle bacilli through blood and bronchial channels makes the breakdown of the tubercle the key problem confronting clinicians and epidemiologists concerned with the prevention of the spread of tuberculosis.

Failure of the individual and of society to make the tubercle invulnerable by the application of the simple rules for healthful living gives rise to the spread of tuberculosis in all its protean forms, necessitating an increasingly costly program of education, diagnosis, treatment, and rehabilitation.

Too wide a gap exists between our scientific knowledge of prevention and its application. Known and proven preventive and diagnostic safeguards are not applied to even contacts eminently endangered by known hazards of age, sex, race, occupation, or environment. Thus, national and local statistics show that year after year some 75 percent of tuberculous cases do not come to diagnosis until in the advanced stages of the disease, and that some 25 percent of the fatal cases are not reported to the Board of Health until after death. Drolet and Whitney have pointed out that no favorable shift has been observed in case rate ratio, over the past ten years.

In a recent high school survey, some 12 of the 13 active cases of tuberculosis disclosed by X-ray, were known household contacts of cases diagnosed in the Honolulu chest clinic since May 1929, but were not under the protection of modern medical techniques. Against the individual indifference to tuberculosis, society has not elaborated the safeguards as about a thousand lesser hazards.

Surveillance of all infected contacts, with application of the simple protective and modern diagnostic technique until their special danger has passed, offers not only control but eventual eradication of tuberculosis.

The logical plan to eradicate tuberculosis, is to disclose and terminate this age old death in the body's primary defense strategy, the tubercle.

ANALYSIS OF CERTAIN FACTORS ENTERING INTO THE MATERIAL WELFARE OF FAMILIES

By

NILS P. LARSEN

The paper was based on two charts worked out in The Queen's Hospital Research Department. Chart one was the analysis of various local diets in comparison with the low cost adequate diet developed by the nutrition committee. On the basis of the cost of this diet a second chart was made out that consisted of the cost of food for families of from one to ten members, and on various incomes.

Using Zimmerman's measurement basis that the most important single criterion in evaluating the material status of families is the percentage of income used for food, the chart indicated at what level the families lived in a degree of "plenty" or in a degree of "poverty." "Plenty" applied if 30 percent or less was used for food, and "poverty" existed if 80 percent or more of the income went into food.

It was shown that families on the plantation salaries could have four children and be "passable," and when they had six or more children they had to live in "poverty," if they fed all the members at least a low-cost, adequate diet.

This study was part of a continued study on the health status of Hawaiian families.

THE PHYSIOLOGY OF OIL PRODUCTION IN THE MACADAMIA

By

WINSTON W. JONES

(Proc., Am. Soc. for Hort. Sci., 35, 1938)

Results reported show that oil formation in the macadamia nut (*Macadamia integrifolia* Maiden et Betche) can be divided into three phases. The first is a period of about 90 days following flowering in which very little oil is formed. The second is a period of about 70 days in which 85 percent of the oil is formed. Following this is a third period of about 70 days before the nuts are ready to harvest and during which very little oil is formed. The beginning of rapid oil formation seems to be associated with the hardening of the shell. Data for the nitrogen and carbohydrate fractions are given.

QUALITATIVE SPECTROCHEMICAL ANALYSIS IN AGRICULTURE

By

STANLEY S. BALLARD

The materials usually encountered in agricultural analytical studies are soils, fertilizers, and plant specimens. Ordinarily one wishes to determine the presence in these materials of the elements essential to plant growth, or those known to be toxic. Also it is necessary at times to analyze substances of heterogeneous composition and frequently those having widely divergent physical characteristics. Any or all of the 92 chemical elements may be sought. Using the methods developed in the spectroscopic laboratory of the Experiment Station of the Hawaiian Sugar Planters' Association, a sample may be analyzed rapidly to determine the presence or absence of some 50 of the elements. This list includes the major plant nutrients phosphorus, potassium, calcium, magnesium, and iron; the minor elements manganese, boron, copper, zinc and aluminum, and some twenty more metals and metalloids occasionally present in agricultural materials. Results of analyses are presented in semi-quantitative form, the five designations representing decreasing amounts of an element present in a sample being: "lots, some, less, trace, not detected." Variations in the amounts of minor elements present in various samples of similar major composition can readily be detected, as illustrated by research projects bearing on the occurrence of the less common plant nutrients in commercial fertilizers, and the distribution of the mineral elements throughout a single stalk of sugar cane. A sample can ordinarily be analyzed semi-quantitatively for the 50-odd arc sensitive elements in one working day. Spectroscopic analysis does not pretend to compete with chemical methods in the quantitative determination of the major constituents of a sample. It has great advantages in speed, ultimate sensitivity and breadth of application, however, when the minor or trace constituents are concerned. Or the spectrograph may be used to advantage in determining the general metallic constitution of a sample whose composition is totally unknown. Again, with the spectrograph comparisons between standardized substances of known composition and unknowns may be carried out easily and rapidly, giving quasi-quantitative results.

SEGREGATION OF SEX TYPES IN THE PAPAYA

By

WILLIAM B. STOREY

Papaya trees may be grouped into three broad classes on the basis of sex type: female, hermaphrodite, and male. Female and hermaphrodite types are fruitful and, therefore, are useful from the grower's point of view; the male type is non-fruiting and its presence in a commercial planting is not desired. Many practices have been devised for the purpose of eliminating male trees in populations intended for field planting, but not one of these has any foundation in fact for its existence and not one has been foolproof in operation.

A system of controlled pollination has been established which makes it possible for the grower to produce seed none of which will produce a male tree. Under controlled pollination the following results are obtained in the progenies:

1. A female crossed with a male yields females and males in the ratio of 1.0 to 1.0.
2. A female crossed with a hermaphrodite yields females and hermaphrodites in the ratio of 1.0 to 1.0.
3. A hermaphrodite crossed with a male yields females, hermaphrodites, and males in the ratio of 1.0 to 1.0 to 1.0.
4. A hermaphrodite when self-fertilized yields females and hermaphrodites in the ratio of 1.0 to 2.0.

By the simple expedient of hand pollination and bagging the flower, using either pollination number 2 or number 4 above, the grower need no longer resort to unproven methods to eliminate male trees from his planting.

GRASSES OF HAWAIIAN RANGES

By

E. Y. HOSAKA AND J. C. RIPPERTON

Agricultural leaders throughout the world are placing more emphasis on grass than ever before. Grass as an agent for holding soil from washing or blowing away, adding organic matter and enriching the soil, and grass as feed for cattle and other livestock is now the object of much research. A. S. Hitchcock in 1922 was the first to make a comprehensive study of the Hawaiian grasses. He reported 130 species, 47 native and 83 foreign. Since

then several new endemic species have been discovered and many foreign species accidentally or purposely introduced from different parts of the world have been added. Hawaii is said to be the crossroad where grasses of the whole world congregate. There are now about 240 grass species in the islands, 54 native and 186 foreign.

Most grasses, contrary to common accepted conception, have a definite habitat. There are species restricted to the wet windward areas, the dry leeward slopes, and the cold dry uplands. In these zones two types of species are found, the sod or carpet and the tuft or bunch formers. Most of the grasses fall in the latter group.

In 1936, Leo D. Whitney*, E. Y. Hosaka, and J. C. Ripperton made a study of the grasses in Hawaii, paying particular attention to the range species. Several months were spent by Hosaka in the field, collecting and making a vegetational survey. In a bulletin to be published by the Hawaii Agricultural Experiment Station, 105 of the more economic species of the Hawaiian ranges are discussed; also, a synopsis of all the known grasses in the Territory is given.

POTENTIAL AGENTS OF BIOLOGICAL CONTROL OF PLANT-PARASITIC NEMATODES

By

M. B. LINFORD

Plant-parasitic nematodes, in soil, are subject to the attack of a vast array of plant and animal enemies, most of which have but recently been recognized. Investigations in progress at the Pineapple Experiment Station since October 1935 have included a survey of parasites and predators occurring in Hawaiian soils and a partial analysis of their significance to agriculture. This paper describes representative types with their mode of attack, presents evidence that they are now helping to combat the destructive and cosmopolitan root-knot nematode, *Heterodera marioni,* and indicates possible means of increasing their beneficial action.

Thus far, 49 distinct species, as enumerated below, have been found locally. All but *Mononchus* and one mite have been new records for Hawaii, many of them new to science. Most attack various plant-parasitic and free-living nematodes with equal ease, but appear harmless to roots.

Thirteen nematode-trapping fungi (Hyphomycetes, Phycomycetes, Basidiomycetes, Actinomycetes), 1 egg parasite (*Penicillium*), 6 non-trapping

* Died November 7, 1937.

parasitic fungi (Chytridiales, Ancylistales, Hyphomycetes), 1 ecto-parasitic protozoan, 19 predacious nematodes (5 *Aphelenchoides, 2 Diplogaster,* 9 Dorylaimidae, and 3 *Monochus*), 6 mites (5 Parasitinae, 1 *Rhizoglyphus*), and 3 predacious tardigrades (*Macrobiotus*).

Some of these have been found in sand, volcanic ash, forest litter and soil, from sea level to 9,700 feet. In fields and gardens where *H. marioni* is established, several are widespread and abundant: 20 species have been found within a radius of 200 yards. In complex associations, these parasites and predators involve undesirable interactions, for they not only compete but also attack and destroy one another.

The biological control complex is now limiting nematode population but, unaided, is not effecting satisfactory control. Some benefits have accrued from experimental addition of a culture of an effective trapping fungus into soil in which it was not abundant. Other benefits, following decomposition of organic matter in soil, are attributable, at least in part, to increased activity of the biological control complex.

JUNGLES OF FIJI

By

HAROLD ST. JOHN

Fiji of the old cannibal days is no more. It is now a British crown colony, with pacified, Christianized natives living under a modern, efficient government. There are still 90,000 natives, mostly dwelling in grass huts in native villages, under their own chiefs.

My expedition during 1937 to Waya Island and to the headwaters of the Wainimala River and the high central plateau of Viti Levu was described and pictured.

NECROLOGY

John Minton Westgate, Director of the Hawaii Agricultural Experiment Station from 1915 to 1935 and Professor of Agriculture at the University of Hawaii from 1935 until the time of his death, died in Honolulu, September 25, 1937.

Professor Westgate was born on February 17, 1878, in Kingston, New York. He received the B. S. degree from Kansas State College in 1897,

and the M. S. degree from the same institution two years later. From 1901 to 1903, he attended the University of Chicago for advanced study.

After twelve years of work in the United States Department of Agriculture, in the field of soil binding investigations and later with clover and alfalfa, he came to Honolulu as Agronomist in charge of the Hawaii Experiment Station which title was changed to Director in 1924.

Westgate was the author of numerous bulletins and papers on agronomical subjects. At the time of assuming his position at the University as Professor of Agriculture, he took a trip around the world spending much time in tropical regions gathering material for courses in tropical agriculture which he gave on his return.

Professor Westgate, to an unusual degree, had a broad sympathy for all classes and races, and contributed greatly to the Americanization of the young people of Hawaii with whom he came in contact.

Upendra Kumar Das, research associate in charge of the biochemical laboratory at the Experiment Station of the Hawaiian Sugar Planters' Association, was instantly killed by an explosion of apparatus in his laboratory on October 22, 1937. His death, equipped as he was for still finer research, has deprived us of a thorough scientist who was always motivated by the practical viewpoint.

Born in India on July 23, 1902, he received his early education at Tagore's School. He came here in 1924 and enrolled at the University of Hawaii. He majored in sugar technology and completed the work for the B. A. degree in three years, graduating with honors in June 1927. After graduation, he found time to secure additional experience in the laboratory of biological chemistry at the University of Hawaii, and in 1930 was awarded a master's degree. During a leave of absence in 1934, he spent a year at the University of Minnesota and received his doctor's degree there. While at Minnesota, he was elected to Sigma Xi.

His associates have lost a sympathetic, constructive counselor, and his friends miss a personality that is not replaceable.

Leo D. Whitney, Assistant Agronomist at the Hawaii Agricultural Experiment Station, died after a week's illness on November 7, 1937. Mr. Whitney was born at Santa Rosa, California, on May 11, 1908. He received his B. S. degree from the University of California in 1933. This was followed by two years of graduate study at the same institution.

During his two years of work in Hawaii, he concentrated on the study of taro, gathering and classifying some eighty varieties. In addition, he did outstanding work on native and introduced grasses of Hawaii. His researches are being completed by his colleagues. He was a faithful and cheerful friend

to all his associates, and industrious and sincere in his search for truth in his chosen field. His early passing is a great loss to science. Surviving are his wife, mother, two sisters, and a brother.

Wilbur James MacNeil, retired member of the faculty of Punahou School, died December 22, 1937.

Mr. MacNeil was a graduate of Cornell University and received an M. S. from that institution. He also did advanced work at Harvard and the University of California.

For thirty-three years, from 1903 to 1936, an instructor in science and mathematics at Punahou Academy, Mr. MacNeil was responsible for the early training of a large number of men and women, many of whom have been prominent in scientific and professional work in Hawaii.

Mr. MacNeil was a member of several national scientific societies and active in local organizations, particularly in the Botanical Society. His work in plant selection and breeding is well known.

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